

Teaching of Undergraduate Chemistry Education Courses Through Information and Communication Technology Integration

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Abstract: This research addressed the need for Information and Communication Technology (ICT) integration in teaching and learning of undergraduate Chemistry education courses. The research identified the rationales for integrating ICT in the teaching of undergraduate Chemistry education courses. The need for Chemistry educators to use information and communication technology for teaching was explored in this research. Given that the significance of ICT cannot be overemphasized, especially in the transfer of knowledge to Chemistry students, Chemistry educator's ICT skills should be improved through exposure to in-service training on ICT utilization. Overall, government at all levels should show concern to Chemistry education departments in educational institutions by providing ICT infrastructure, training as well as providing an enabling environment for its utilization. On the other hand, educational agencies should compliment Chemistry educator's efforts in making teaching and learning interesting and motivating through ICT facilities provision.

Key words: Teaching, undergraduate, Chemistry education course, information and communication technology integration, government, identified

INTRODUCTION

Conceptual framework: Many researchers have explored the relevance of Information and Communication Technology (ICT) to teaching and learning of science courses at secondary education level but remained reluctant in the understanding of the usefulness of ICT in teaching undergraduate Chemistry education courses. Information and communication technology according to Adeosun (2002) provides access to relevant information through telecommunications. According to the scholar, its mode of operation includes the internet, wireless networks, cell phones and other communication mediums. By Becta (2008), ICT is a technology that is used to process information, store information and transmit information for communicating information, creating information or for the exchange of information. The researcher stated that ICT is used as computing and communication facilities in education. Adeyemi and Olaleye (2010) opined that the application of ICT is necessary for the collection of student data, recording of student results and for the effective keeping of student records. Data of various types could be programmed into the computer and retrieved at a later date when needed. This research, therefore, expresses opinion on the integration of Information and Communication Technology (ICT) in the teaching of undergraduate Chemistry education courses. Adeosun (2002) was of the view that through information and communication

technology processes, the problems sociated with the teaching and learning of Chemistry education will be eliminated. Onifade (2003) opined that the use of information and communication technology strengthens teaching and learning. Greenberg (2004) opined that many technological tools are in use in the 21st century for teaching and learning but the most important thing is thinking on the ones that would bring about positive outcomes in teaching and learning.

ICT integration in undergraduate Chemistry education courses: Wright *et al.* (2007) observed that the lack of ICT accessibility and utilization is discouraging to teaching in developing countries. By Jimoh *et al.* (2012), it difficult to advance modern teaching and learning in developing countries without basic facilitates such as computers, software, adequate space to plan instruction and personnel with technological know-how. Thus, the main purpose of this review is to opine on how ICT can be incorporated into the teaching of undergraduate Chemistry education courses. Yusuf (2005) opined that ICT for better teaching and learning has been quite challenging despite efforts by the government to ensure equitable distribution of computers to institutions of higher learning in developing countries like Nigeria. Abolade and Yusuf (2005) noted that successful integration of ICT in Nigerian higher education institutions will require as retraining of lecturers in order to be fully involved. Adegun pointed out that the problem

facing Nigerian higher institutions is the preliminary way in which ICT is utilized in institutions of higher learning. Thus, Adedokun-Shittu by Ajayi (2002) was of the view that restoration of teaching and learning in the higher institutions would require the proper application of ICT.

The essence of integrating ICT in teaching undergraduate Chemistry education courses is to incorporate students as educational researchers, make them creative, promote novelty being conversant with how to learn with ICT and being able to meet global Chemistry education expectations among others (Adedokun-Shittu and Shittu, 2011). Ecclestone opined that students and teachers technological know-how can add meaning to the student's learning and simulations. Adedokun-Shittu (2012) noted that ICT can make Chemistry teaching and learning easy, practicable, improve learning motivation and enhance teacher's and student's ability to use ICT comfortably. Liu and Liu and Velasquezbryant asserted that the benefits of ICT have made teachers to embrace its application to teaching and learning. It is argued therefore that the use of ICT as a means of teaching and learning will not only change the pattern of Chemistry learning but could improve the interactivity, standard and effective teaching of Chemistry education courses taught to undergraduate students. Burns and Myhill noted that interactive learning gives access to discussion and independence in reasoning.

Okeke (2005) asserted that students of Chemistry education hardly give acceptable meaning to some concepts and often attach wrong meaning to them. As a technique to help ameliorate this issue, undergraduate Chemistry education courses should be taught using ICT in order to make the students active learners. Njoku (1997) had reported that poor teaching methods in which students were exposed to can deny them the privilege of knowing Chemistry formulas and its applicability. However, Hargreaves *et al.* opined that ICT application can help rebrand the teaching of undergraduate Chemistry education courses. To this end, ICT can promote effective teaching of Chemistry by:

- Integrating all Chemistry students into the learning process
- Actively involving Chemistry students in the acquisition of practical experiences
- Helping Chemistry students to utilize their knowledge to attend to issues related to chemical education
- Helping Chemistry students to work in a group to achieve their study goals
- Improving thinking and learning skills of Chemistry students

Trucano (2005) asserted that ICT empowers students to be skilful and dedicated while being enriched with technological skills to fit into the world of work. Wright *et al.* (2007) explained that ICT can provide undergraduate students with new ideas; help them get involved in an online learning and read widely in their discipline and beyond.

THEORETICAL FRAMEWORK

Technology Acceptance Model (TAM): The theory of technology acceptance model was theorized by Davis *et al.* (2009). The theory's rationale is to predict and elicit information and communication technology practice. The premise is on what stimulates potential adopters to accept or reject the application of information technology. The technology acceptance model have two theoretical constructs, perceived usefulness and ease of use which is the fundamental determinants of system use and predict attitudes toward the use of the system that is the user's willingness to use the system. Perceived usefulness refers to the degree to which a person believes that using a particular system would enhance his or her job performance while perceived ease of use refers to the degree to which a person believes that using a particular system would be free of effort.

Information systems success model: The theory of information systems success model was propounded by DeLone and McLean. This theory introduced a comprehensive taxonomy of factors contributing to the success of information systems and categorized success measures into six major categories namely, system quality, information quality, use, user satisfaction, individual impact and organizational impact. These categories are interrelated and interdependent and provide a comprehensive view of information system success.

Literature review: Ifeakor (2005) investigated the effects of commercially produced computer-assisted instruction package on student's achievement and interest in Chemistry. The purpose of the study was to ascertain ways of improving student's performance and interest in Chemistry through the application of computer-assisted instruction package comparing it with students taught with conventional methods. The study design was pretest-posttest quasi-experimental non-randomized group control type involving intact classes. A total of 140 SS2 students were sampled for the study. The study indicated that most teachers were not properly informed on the use of computer-assisted instruction and therefore would not improve teaching and learning.

Okeke (2011) conducted a study on the effects of mind mapping teaching strategy on student's achievement, interest and retention in senior secondary school Chemistry. The purpose of the study was to understand ways of improving Chemistry student's achievement, interest and retention capacity in order to function actively in the world of work. The population consists of 4698 with 194 sample size. The study design was pretest-posttest quasi-experimental. Mean and standard deviation was used to answer research questions while analysis of covariance was used to test null hypothesis. The result revealed students taught MMTS improves Chemistry education courses than CTM.

Anaekwe (1997) conducted a study on the effects of student's interaction pattern on student's achievement, interest and retention in Chemistry. The purpose of the study was to understand ways of improving Chemistry student's achievement, interest and retention capacity in order to function actively in the world of work. The study design was pretest-posttest quasi-experimental. The study was conducted using four research questions and four hypothesis. Mean and standard deviation was used to answer research questions and hypothesis. The study revealed interaction pattern occurs more positively in female than male.

Alharbi investigated the use of ICT in teaching in secondary schools in Kuwait. The purpose of the study was to ascertain the level and impact of ICT on teacher's pedagogy, the student's perception of ICT use in the classroom and to seek out any fundamental differences in public and private education as well as across genders. Four research questions guided the study. Mixed-method was used to gather information. The result revealed that teachers and students were incompetent to apply information and communication technology in teaching and learning of Chemistry education courses even though that teacher believed that information and communication technology will improve effective teaching and learning of Chemistry education.

Bilani, El and Jean-François Le Marechal explored the use of ICT in Chemistry teaching at upper secondary level. The purpose of the study was to describe teacher's cognitive difficulties in the use of ICT in Chemistry classroom teaching at upper secondary schools. The population of this study was 9000 while 1390 were sampled as the sample size for the study. The investigation was carried out using the threefold method. Two research questions guided the study. The questionnaire was used for data collection while percentage was used for data analysis. The study revealed among others that teachers and students reflect more efficiently with the use of ICT.

Adeyinka *et al.* carried out a study on assessment of secondary school teacher's uses of ICTs; implications for further development of information and communication technology use in Nigerian secondary schools. The population of the study constitutes of all private secondary school teachers in Ibadan, the capital of Oyo State, Nigeria. The sample size was 700 respondents. The study data was analyzed using frequency and percentages. A modified instrument tagged "Teachers ICT use survey" adapted from ICT survey indicator for teachers and staff by Anonymous (2004, 2006) and ICT Teachers Survey by New Zealand Ministry of Education MINEDU (1999) was used for the collection of data. The study was guided by five research questions. The results showed that teachers generally have access to ICTs in their various schools except for e-mail and internet because their schools are not connected. Technical support is lacking in the schools and teacher's dearth of expertise in using ICT was indicated as being the prominent factors hindering teacher's readiness and confidence of using ICTs during the lesson. Furthermore, the results showed that teachers perceived ICT as being easier and very useful in teaching and learning.

Duncan and Barczyk conducted a study on Facebook's effect on learning in higher education; an empirical investigation. The study purpose was to ascertain if Facebook-enhanced courses facilitate an increased community of practice, sense of learning and sense of connectedness compared to non-enhanced courses. The study used survey research design to compare the responses of 586 students who were enrolled in Facebook-enhanced business courses with those who were not. Three research questions guided the study. Research findings showed that students in the Facebook-enhanced courses experienced a somewhat more positive community of practice, sense of learning and sense of connectedness compared to students in non-Facebook-enhanced courses.

Schroeder and Greenbowe (2009) conducted a study of undergraduate students in a basic organic Chemistry laboratory who participated in an optional, out-of-class Facebook discussion group. Students who participated in the Facebook discussion group posted items more frequently and dynamically than those in the official course website. Also, Cox *et al.* (1999) observed a number of factors that contribute to the continuous use of ICT by teachers. The scholars were of the view that ICT assists in making lessons more benefiting, interesting, faster, more diverse, more inspiring for the students and more explorable for both teachers and students. Tella *et al.* (2007) also discovered that computer use was predicted by intentions to use it and that perceived usefulness was also correlated to its intentions. In all if ICTs are

accessible it will encourage Chemistry education lecturers/teachers to skillfully apply it during class discussions or teaching and learning. McCarney (2004) explored the knowledge and skills gained by teachers from staff development and report the need for a much greater awareness to be placed on the pedagogy underlying information and communication technology use. Moseley (1999) (cited by Anonymous, 2004) stated that teachers who favoured ICT will have well-developed ICT skills and also will perceive ICT as an essential tool for teaching and learning. To the researchers, teachers who favour information and communication technology will appreciate working as a team assessing information and allowing students to make a ascertain decision regarding their learning.

Marshall, Elgort and Mitchell reported that staff continues to discover the dearth of time as an impediment to the use of ICT equipment. While some understand this to denote that staff have not have had the time to obtain the required abilities in the use of technology in teaching it also reflects a sense of main concern expressed by the institution and a wish by academics to see a return on the investment of their time in mounting their teaching with technology. Surveys of academic staff attitudes toward the use of technology have also repeatedly identified time and an absence of skills and knowledge as important impediments to technology implementation (Marshall, 2000). In another study, the biggest impediment to the use of computers identified by teachers was also, the dearth of time in classes and daily school tricks rather than physical resources (i.e., hardware, software, electricity) and the lack of a national policy on the use of computers in schools (Kozma *et al.*, 2004).

NEED FOR APPLICATION OF ICT IN CHEMISTRY TEACHING AND LEARNING

The need for integrating ICT in eliminating challenges in the teaching of undergraduate Chemistry education courses cannot be overemphasized:

- It can expose Chemistry teachers and students to the moving and acceptable trend or direction in teaching and learning of Chemistry
- It can make Chemistry student's knowledge more dependable
- It can equip teachers with new ideas, methodology and approach applicable to teaching and learning of Chemistry
- It can revolutionize the state of undergraduate Chemistry education courses
- It can enable Chemistry teachers to know when they are directionless in the process of teaching
- It can allow Chemistry students to access current knowledge and improve their abilities in Chemistry

- It can enable Chemistry students to learn without depending wholly on their teachers but to tap from wider knowledge

Moon (2000, 2003), Leach and Moon (2002), Leach (2003) have all pointed out the potential benefits of ICT for transforming the models and processes of teacher development as well as for enabling access to quality resources and professional supports. Deducing from (Leach *et al.*, 2002), ICT offers:

- Scaffolding instruments that can enhance Chemistry teacher's acquisition and understanding of new professional skills
- Background and new contexts for Chemistry learning which can facilitate the experience of new ideas, methodology and people
- Communicative instruments which can smooth the progress of social participation structures between Chemistry teachers and other educational experts
- Cognitive instruments which can allow reflection on the learning process in Chemistry education both at individual and group level

Furthermore, a number of researchers have emphasized the use of ICT in teaching and learning (Bransford *et al.*, 1999; Leach and Moon, 2000; Mumtaz, 2000; Cox *et al.*, 1999) and have shared key issues such as.

That ICT usage depends on the teacher effectiveness accustomed to specific teaching and learning contexts (Davis *et al.*, 2009; Somekh, 2001; Caswell and Lamon, 1999; Moseley, 1999; Brown and Duguid, 2000).

That classroom-and curriculum-focused teacher professional development crucial element in realizing investment in the provision of ICT.

By implication, there are some underlying issues in the applicability of ICT in developing countries. Anderson (1997, 2002) noted a number of reasons as predominant issues that affect information and communication technology use by teachers to include physical and cultural factors. In addition, educational factors including levels of teacher's own education and literacy rates and access to professional development play important roles.

It is important to assert that ICT is an essential tool for raising the height of any meaningful industry. By this, the government should endeavour to equip institutions of higher learning, especially as it affects Chemistry education, so that, desirable learning environment will be created for Chemistry education students. UNESCO., added that gaining a full package of ICT demands pre-service and on the job training for teachers. They

further noted that ICT helps in resolving issues such as pedagogical, collaboration and networking, social issues and technical issues.

CONCLUSION

The poor learning and achievement of Chemistry education students is worrisome to researchers. The application of ICT can restore educational strength and academic dignity of undergraduate students enrolled in Chemistry education courses. The significance of ICT cannot be overemphasized, especially in the transfer of knowledge to Chemistry students. The need for Chemistry educators to use ICT for teaching was demonstrated in this research. Chemistry educator's ICT skills can be improved if they will be exposed to in-service training. To this effect, government at all levels should show concern to Chemistry education departments in educational institutions by providing ICT infrastructure, training as well as an enabling environment for its utilization. Finally, educational agencies should compliment Chemistry educator's efforts in making teaching and learning interesting and motivating through ICT facilities provision. There is need for training and professional development-focused initiatives that would promote ICT-based Chemistry teaching models in Nigerian higher education institutions.

RECOMMENDATIONS

The government should pay more concern to the provision of information and communication technology infrastructure in order to encourage the use of ICT in the teaching and learning of Chemistry. Chemistry educators in higher institutions irrespective of personal status should be exposed to ICT training.

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